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Jaques Scheuten

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EXAMINER

BERDICHEVSKY, MIRIAM

ART UNIT

PAPER NUMBER

1723

NOTIFICATION DATE

DELIVERY MODE

08/04/2011

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary

Application No.

10/574,633

Applicant(s)

SCHEUTEN ET AL.

Examiner

MIRIAM BERDICHEVSKY

Art Unit

1723

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on rce 6/10/2011.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-43 is/are pending in the application.
- 4a) Of the above claim(s) 21-40 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20, 41-43 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Remarks

Claims 21-40 are withdrawn. Claims 1, 4-6, 10-11 and 19 are amended. Claims 42-43 are new. Claims 1-20 and 41-43 are currently pending.

Status of Objections and Rejections

The objections from the previous office action are withdrawn in view of Applicant's amendments.

All other rejections are withdrawn in view of Applicant's amendment. New rejections are presented as necessitated by amendment.

Claim Objections

1. Claim 10 is objected to because of the following informalities: the Examiner's position that "has" in line 2 should read "having". Appropriate correction is required.
2. Claim 41 is objected to because of the following informalities: the Examiner's position that "of" should be inserted after "magnitude" in line 2. Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
4. Claim 41 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Art Unit: 1723

5. The term "approximately" in claim 43 is a relative term which renders the claim indefinite. The term "approximately" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The claim will be given the broadest reasonable interpretation wherein the "order of magnitude [of] approximately 0.2mm" will encompass 0.1-0.9mm (i.e. order of magnitude is the tenths).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. Claims 1-5 and 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata (EP 0940860), Gay (US 4638111) and Probst (US 5626688).

As to claim 1, Nakata teaches a spherical shaped semiconductor for use in solar cells made by applying a conductive back contact directly onto a spherical substrate core ([0072], 22 on 21: figure 14) and forming an absorber layer from a precursor layer

Art Unit: 1723

([0072]: seed layer). Nakata teaches that CIS (copper, indium, selenide/sulfur) layers can be formed instead of silicon as the conversion layer of the spherical solar cell ([0076]) but is silent to the particulars for forming CIS solar cells including the back contact being molybdenum and the substrate core being soda lime glass.

Gay teaches that CIS is formed by applying a molybdenum back contact layer directly to a glass substrate (col. 8, lines 50-55) and then depositing a precursor layer of copper, depositing a precursor layer of indium followed by reacting these precursor layers in the presence of a hydrogen compound of selenium (col. 9, lines 1-15). Gay is specifically silent to the use of soda-lime glass. Probst teaches a conventional CIS solar cell comprising a soda lime glass substrate (col. 1, lines 25-35), a Mo back contact layer (col. 1, lines 25-35). Alternatively, the substrate is interpreted as comprising the soda lime glass substrate and the diffusion barrier (col. 5, lines 1-10) on which the molybdenum layer is directly deposited (col. 5, lines 15-20). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the materials of Probst in making the spherical CIS solar cell with a soda lime glass substrate and a Mo contact layer because Probst teaches that soda lime glass is known to have a positive influence on the cell, as taught by Probst (col. 1, lines 30-37 and lines 55-60) especially since it has been held to be within the skill of a worker to select a known material based on its suitability for the intended use (MPEP 2144). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the particulars of Gay to form the CIS spherical solar cell of Nakata because the methods of Gay achieve enhanced efficiency (Gay: col. 2, lines 55-60). The Examiner notes that the instant

Art Unit: 1723

claimed invention "optionally further comprises a gallium layer" such that the gallium layer is not required by the prior art and therefore the rejection reads on the instant claimed invention.

Regarding claim 2, modified Nakata teaches a Mo conductive layer (Gay: col. 8, lines 50-55). It also would have been obvious to use the metal layer of Gay in modified Nakata because Gay teaches Mo as the preferred material for the CIS absorber layer (col. 8, lines 50-55) especially since it has been held to be within the skill of a worker to select a known material based on its suitability for the intended use (MPEP 2144).

Regarding claim 3, modified Nakata does not teach the use of Ga (0%) which reads on the instant claim. The Examiner notes that "in order to improve adhesion" is functional language and does not impart a structural difference between the prior art and the instant claimed invention which merely requires 0-20% Ga in the back contact layer.

Regarding claim 4, modified Nakata teaches that the layers are deposited with PVD (Gay: col. 9, lines 5-10).

Regarding claim 5, modified Nakata teaches heating the precursor layers to 400°C prior to reacting the layer to form the CIS compound (Gay: col. 9, lines 10-15). The Examiner notes that the substrate will be heated to above 220°C (400°C), before the reaction takes place during which alloying will occur, thereby reading on the instant claimed invention.

Regarding claim 7, modified Nakata teaches depositing a buffer layer after forming the CIS layer (Gay: col. 9, lines 15-20).

Regarding claim 8, modified Nakata teaches depositing a high resistance ZnO layer and a low resistance ZnO layer after forming the CIS layer (Gay: col. 9, lines 15-45).

Regarding claim 9, modified Nakata teaches that the buffer layer is deposited by CVD (col. 9, lines 15-20).

9. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata, Gay and Probst as applied to claim 1 above and further in view of Menezes (US 20030230338).

Regarding claim 6, modified Nakata is silent to a KCN treatment after formation of the CIS layer. Menezes teaches that conventional p type CIS layers require a KCN etch ([0011]) to remove impurities. It would have been obvious to one of ordinary skill in the art at the time of the invention to etch the p-type CIS cell of modified Nakata in KCN because Menezes teaches it is required in such cells ([0011]).

10. Claims 10-17, 20, 41 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata, Probst and Gay.

Regarding claims 10 and 20, Nakata teaches a spherical solar cell comprising an insulating substrate core directly coated with a back contact layer (22 on 21: [0072]) and a CIS compound semiconductor ([0011], [0076] and [0077]). Nakata is silent to the particulars of the spherical solar cell materials when the solar cell has a CIS (I-III-VI compound semiconductor) absorber layer and is therefore silent to the insulating substrate being soda lime glass and the contact layer being Mo. Probst teaches a conventional CIS solar cell comprising a soda lime glass substrate (col. 1, lines 25-35),

Art Unit: 1723

a Mo back contact layer (col. 1, lines 25-35) directly deposited thereon. Alternatively, the substrate is interpreted as comprising the soda lime glass substrate and the diffusion barrier (col. 5, lines 1-10) on which the molybdenum layer is directly deposited (col. 5, lines 15-20). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the materials of Probst in making the spherical CIS solar cell with a soda lime glass substrate and a Mo contact layer because Probst teaches that soda lime glass is known to have a positive influence on the cell, as taught by Probst (col. 1, lines 30-37 and lines 55-60) especially since it has been held to be within the skill of a worker to select a known material based on its suitability for the intended use (MPEP 2144). The Examiner notes that the instant claimed invention "optionally further comprises a gallium layer" such that the gallium layer is not required by the prior art and therefore the rejection reads on the instant claimed invention.

Further regarding claim 20, claim 20 is a product claim such that the method steps are considered product by process and even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113).

Regarding claims 11 and 41, modified Nakata teaches specific substrate core examples of 2.5mm (Nakata: [0072]), 1.5mm (Nakata: [0084]) and that the invention of Nakata is not limited to this diameter but can have larger or smaller diameters (Nakata:

Art Unit: 1723

[0031]). Modified Nakata is silent to the substrate core diameter being 0.1mm to 1mm (claim 11) 0.9mm or less (magnitude of 0.2mm: claim 41). It would have been obvious to one of ordinary skill in the art at the time of the invention to use smaller cores to reduce material costs and overall cell dimensions while maintaining a core size with dimensions capable of processing especially since it has been held that where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device (MPEP 2144).

Regarding claim 12, modified Nakata teaches that the Mo layer is 1 micron thick (Probst: col.5, lines 10-15).

Regarding claim 13, modified Nakata teaches that the CIS layer is copper indium diselenide (Nakata: [0076] and Probst: col. 9, lines 5-10).

Regarding claim 14, modified Nakata teaches that the CIS layer is 2 microns thick (Probst: col. 8, lines 15-20).

Regarding claims 15-17, modified Nakata teaches a CdS (claim 16) buffer (claim 15) layer between 10 and 50nm (claim 17) formed above the CIS layer (col. 8, lines 25-30). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists (MPEP 2144).

Regarding claim 43, modified Nakata teaches that the back contact layer is molybdenum (Probst: col. 5, lines 1-15).

Art Unit: 1723

11. Claims 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata and Probst as applied to claim 10 above and further in view of Gay.

Regarding claims 18-19, Probst teaches the use of a 1.5 micron layer of ZnO which can be used in combination with other layers but modified Nakata is specifically silent to a low and high resistance layer as well as their thicknesses.

Gay teaches a conventional CIS solar cell comprising high and low resistance ZnO layers on the CIS layer wherein the high resistance layer has a thickness between 70 and 200nm and the low resistance thickness is 1 micron (col. 9, lines 30-50). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists (MPEP 2144). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the multi resistance layer of Gay in modified Nakata because they provide high transmittance, as taught by Gay (col. 8, lines 30-40).

12. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata, Gay, Probst as applied to claim 1 above and further in view of Kim (*Effect of selenization pressure on CuInSe₂ thin films selenized using co-sputtered Cu-In precursors*).

Regarding claim 42, modified Nakata is silent to specifically performing selenization at or below atmospheric pressure. Although, one would appreciate that when conditions are not specified standard conditions are obvious (standard pressure is 1atm or atmospheric pressure), in an effort to expedite prosecution, Kim teaches that the pressure at which selenization is performed to form CIS layers is a result effective

Art Unit: 1723

variable (figure 9). It would have been obvious to one of ordinary skill in the art at the time of the invention to use the particulars of Gay to form the CIS spherical solar cell of Nakata because the methods of Gay achieve enhanced efficiency (Gay: col. 2, lines 55-60). It would have been obvious to one of ordinary skill in the art at the time of the invention to use 1 atm because Kim teaches that resistivity is minimal using 1atm (figure 9) especially in light of the fact that as Gay does not teach a specific pressure one would assume standard pressure conditions (atmospheric). Moreover, it has been held to be within the skill of a worker in the art to optimize a result effective variable such as selenization pressure to achieve a desirable result, in this case minimize resistivity (MPEP 2144).

Response to Arguments

Applicant's arguments filed 6/10/2011 have been fully considered but they are not persuasive.

Applicant argues that one would not have substituted a glass core for the metal core in Nakata due to reliability issues and adhesion problems. The Examiner is not persuaded. Nakata teaches that various substrate core materials are possible including transparent insulating materials with a thermal expansion coefficient close to that of the semiconductor material ([0011]). In addition, Nakata teaches that materials used in known solar cells such as CIS (CuInSe_2) can be used ([0076]). One would appreciate that upon constructing a CIS solar cell it would have been obvious to one of ordinary skill in the art to use the substrate and back contact materials associated with these types of cells as taught by Probst to include soda lime glass which has a positive

Art Unit: 1723

influence on CIS cells (Probst: col. 1, lines 30-37 and 55-60) and molybdenum (also taught by Gay). Although Probst teaches that poor adhesion was a problem (col. 2, lines 4-6); the method of Probst avoids the problem of deteriorated adhesion between layers encountered previously (col. 2, lines 35-40). Gay teaches that adhesion promotion was known in the art and that a CIS cell lacking adhesion promoter (Probst's diffusion barrier) has the expected and predictable result of less adhesion, as its use is optional (Gay: col. 8, lines 55-60). It would have been obvious to one of ordinary skill in the art at the time of the invention to directly deposit the molybdenum layer on the substrate to reduce manufacturing steps and materials with the predictable result of lowered adhesion (MPEP 2144). Moreover, when the substrate is interpreted as comprising soda lime glass and a diffusion barrier, the improved adhesion of Probst is further motivation to use the materials of Probst when constructing the CIS solar cell of Nakata. It would have been obvious to one of ordinary skill in the art at the time of the invention to use a glass core substrate in modified Nakata because glass is cheaper than high grade semiconductors, as taught by Nakata ([0011]).

Applicant argues that the Probst requires a diffusion barrier and therefore the combination does not teach the molybdenum deposited directly on the soda lime glass core. Applicant argues that the instant claimed invention lacks a diffusion barrier. The Examiner respectfully disagrees. Firstly, regarding claims 1-9, Gay is relied upon as a teaching of direct deposition of molybdenum on the substrate such that this argument is moot. Secondly, Applicant's arguments are not commensurate with the scope of the claims; the claims do not require that the solar cell "lack[s] a diffusion barrier (adhesion

Art Unit: 1723

promoter)". The claim uses "comprising" which is open language such that, as in the above rejection, the substrate is interpreted as comprising the soda lime glass substrate and the diffusion barrier (Probst: col. 5, lines 1-10) on which the molybdenum layer is directly deposited (Probst: col. 5, lines 15-20) thereby reading on the claims. The claim does not require that the molybdenum layer is directly deposited on the soda lime glass. Finally, Probst teaches that it is known in the art to directly deposit molybdenum on the soda lime glass substrate (col. 1, lines 25-30) and that soda lime glass results in improved CIS cells over other substrate materials (col. 1, lines 33-36 and 55-60) which can be controlled by pretreatment of the substrate and deposition conditions of the back electrode (col. 1, lines 60-67). Probst teaches that it was known in the art at the time of the invention that diffusion of alkali elements from the substrate is a manner in which to improve efficiency and other properties of the solar cell (col. 2, lines 20-25). Therefore, although Probst goes on to teach the inclusion of alkali metals using a different solution, a barrier layer and dosed addition of alkali metals (col. 3, lines 20-25); Probst teaches that the limitations of the instant claimed invention were known at the time of the invention, molybdenum directly deposited on glass wherein alkali metals diffuse from the glass into the CIS layer to increase efficiency (col. 1, lines 25-60). One would appreciate controlling the alkali diffusion by previous methods (substrate treatment) or using the new method proposed by Probst with a reasonable expectation of similar results (MPEP 2141). Finally, Gay teaches that adhesion promotion was known in the art and that a CIS cell lacking adhesion promoter (Probst's diffusion barrier) has the expected and predictable result of less adhesion, as its use is optional (Gay: col. 8, lines

Art Unit: 1723

55-60). It would have been obvious to one of ordinary skill in the art at the time of the invention to directly deposit the molybdenum layer on the substrate to reduce manufacturing steps and materials with the predictable result of lowered adhesion (MPEP 2144).

Applicant argues that the use of soda lime glass substrate spherical core with molybdenum directly deposited thereon produces unexpected results, providing the right amount of sodium for improved CIS cells unlike seen in flat substrate cells. The mere allegation of unexpected results is not persuasive. Applicant has not provided sufficient evidence that the substrate spherical shape of soda lime glass with molybdenum directly deposited thereon unexpectedly achieves improved adhesion and efficiency over flat substrates with molybdenum directly deposited thereon. Moreover, the lack of the adhesion promoter (barrier layer) of Probst would have the expected result of reducing adhesion, as taught as being optional by Gay (col. 8, lines 55-60).

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to **MIRIAM BERDICHEVSKY** whose telephone number is (571)270-5256. The examiner can normally be reached on M-Th, 10am-8pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 1723

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MIRIAM BERDICHEVSKY/
Examiner, Art Unit 1723